Items Identified By EPA As Not Being Sufficiently Addressed in the CCA and Requiring Additional Information

Content of Compliance Certification Application

194.14(a)(2)
Section 194.14(a)(2) requires that a description be provided of the "...geochemistry of the disposal system and its vicinity and how these conditions are expected to change and interact over the regulatory time frame."

Section 6.4.3.4 &.5 of the Compliance Certification Application (CCA) provides solubility values for dissolved actinides in Castile and Salado brine. Both plutonium and americium are much more soluble in Salado brine than in Castile brine. The assumption is made that, in any scenario involving a Castile brine reservoir, all of the brine in the waste panel will be Castile brine.

DOE needs to provide a justification of this assumption.

194.14(a)(2)
Section 194.14(a)(2) also requires "a description of the...hydrology...of the disposal system and its vicinity and how these conditions are expected to change and interact over the regulatory time frame." This is to include the estimated vertical flow of groundwater for each geological unit expected to transmit radionuclides to the accessible environment during the regulatory time frame.

Section 2.2.1.1 of the CCA discusses the conceptual model for regional groundwater flow around the WIPP. However, estimated vertical flow of groundwater into and between these transmissive units is not provided. This estimation of vertical flow includes estimates of infiltration at the surface and into immediate underlying geologic units.

DOE needs to include: 1) the estimated infiltration at the surface and to the Dewey Lake; and 2) the estimated vertical flow of groundwater into other transmissive units within the area surrounding the WIPP.

Models and Computer Codes

194.23(a)(1)
Section 194.23(a)(1) requires a description of the conceptual models and scenario construction.

While Appendix MASS: Attachments 15-2, 15-8 and 15-9 describe the transport of colloids

in the Culebra, more information is required to justify the assumptions made regarding these transport mechanisms. Specifically, Attachment 15-2 concludes with the following, "In summary, a particular colloid will be modeled in one of two ways depending on the colloids dominant retardation mechanism. If sorption is the dominant mechanism, the colloid will be treated nearly the same as a dissolved actinide, see Table 1. However, if filtration is the dominant retardation mechanism, matrix diffusion will be disabled and the decay constant will be used to filter out colloids. Of course other combinations are possible should a particular colloid require special consideration." This approach appears to treat the migration of colloids in the same manner as other radionuclides and does not address the special concerns related to the facilitative transport associated with colloids (e.g., colloids can move faster than the bulk velocity of the groundwater).

The Department needs to provide information to justify treating the transport of colloids and radionuclides in the same manner. In addition, the information on filtration versus sorption needs to be clarified, specifically how the filtration properties of crushed dolomite compare with fractures in the Culebra, or how the effects of filtration were separated from those of sorption.

194.23(a)(1) & **194.23(a)(2)**
Sections 194.23(a)(1) and 194.23(a)(2) require a description of the conceptual models and alternative plausible conceptual models and an explanation of the reason why such alternative models were not deemed accurate.

Appendix MASS states "The conceptual model used in performance assessment for groundwater flow in the Culebra treats the Culebra as a confined two-dimensional aquifer with constant thickness and spatially varying transmissivity." The treatment of the Culebra as a fully confined system is contradictory to the modeling results presented by Corbett and Knupp (CCA Reference No. 147) which indicate on Page 5 that "Vertical leakage may contribute as little as 5 % or more than 50% of the total inflow to the portion of the Culebra that lies within the WIPP-site boundary."

The Department needs to provide additional support for the use of a fully confined system for the conceptual model, including information on why the Culebra should not be treated as unconfined (an alternative conceptualization) in certain areas.

194.23(a)(3)(I)
Section 194.23(a)(3)(I) requires that “conceptual models and scenarios reasonably represent possible future states of the disposal system.”

As an essential component of the conceptual models, DOE has introduced MgO as a chemical additive to buffer the chemistry of the radionuclides so as to lower the pH and thus their solubility, and thereby limit transport. The Department states in Appendix BACK that approximately two times the amount of MgO needed to absorb the maximum expected CO_2

generated will be emplaced in the disposal rooms. The Department, however, has not provided

documentation in the CCA verifying that the expected chemical reaction will in fact progress as expected and completely absorb the CO_2 generated.

The Department needs to provide experimental evidence to support these assumptions.

194.23(a)(3)(I)
Section 194.23(a)(3)(I) requires documentation that "the conceptual models and scenarios reasonably represent possible future states of the disposal system."

In Appendix BACK, the Department states that bags of cellulose or plastic will protect the MgO from premature exposure to the atmosphere without providing supporting evidence.

The Department needs to provide evidence that CO_2 will not diffuse through or otherwise penetrate the bags during the operational phase and reduce the post-closure capability of the MgO.

194.23(a)(3)(ii)
Section 194.23(a)(3)(ii) requires documentation that the "mathematical models incorporate equations and boundary conditions which represent that mathematical formulation of the conceptual models."

The BRAGFLO User's Manual is unclear on how the effects of wicking are integrated into the mathematical model.

The Department needs to clarify the incorporation of wicking into the mathematical model.

194.23(a)(3)(iv)
Section 194.23(a)(3)(iv) requires documentation that the "...computer codes are free of coding errors and produce stable results."

One feature of the SECOFL2D computer code (SECO User's Manual) that was not tested was that the code implements the transition from a regional grid to a local grid.

The Department needs to devise a test of this key component and document the accuracy of the bilinear interpolation scheme for both boundaries and properties.

194.23(a)(3)(iv)
Section 194.23(a)(3)(iv) requires "computer models accurately implement the numerical models" and are free of coding errors and produce stable results.

Appendix PAR identifies the assigned values for both longitudinal and transverse dispersivity in the Culebra as 0.0. Although this value would appear to lead to conservative results by reducing the amount of surface area available for matrix diffusion, there is insufficient evidence presented in the CCA that the SECOTP code will provide stable solutions at such low dispersivities. In fact, in a letter from James McCord to James Ramsey (Sandia National Lab), provided as an attachment to the Parameter Record Package for non-Salado longitudinal dispersivity, Dr. McCord states "Assuming that the numerical codes used correctly solve the governing partial differential equations, simulations using local dispersivities less than or equal to 2 m will yield results consistent with field scale dispersive spreading observations as reported by Gelhar et al. (1992)."

The Department needs to provide evidence that the numerical solver method implemented in the SECOTP code correctly solves the partial differential equations at dispersivities of 0.0 over the range of Courant numbers used in the CCA.

194.23(a)(3)(iv)
Section 194.23(a)(3)(iv) requires “computer models accurately implement the numerical models.”

In regard to the BRAGFLO computer code, Appendix MASS states "Approximating convergent and divergent flow around the intrusion borehole and the shaft creates two narrow necks in the otherwise fairly uniform width grid in the region representing the repository. In the undisturbed performance scenario and under certain conditions in other scenarios, flow in the repository may pass laterally through these necks. In reality, these necks do not exist. Their presence in the model is expected to have a negligible or conservative impact on model predictions compared to predictions that would result from use of a more realistic model geometry." The text further states that "The time scale involved and the permeability contrast between the repository and surrounding rock are sufficient that lateral flow that may occur in the repository is restricted by the rate at which liquid gets into or out of the repository, rather than the rate at which it flows through the repository." To support this contention, a grid study comparing a two-dimensional and three-dimensional model was performed and included as MASS Attachment 4-1. The results of this analysis indicate that under undisturbed performance the grids would provide similar answers. However, the models were parameterized such that, in both cases, brine did not flow up the borehole following an intrusion and therefore, the adequacy of the grid under disturbed conditions cannot be evaluated.

The Department needs to provide a similar analysis that is representative of an intrusion scenario in which brine reaches the Culebra. That is, the pressures in the repository have to be high enough so brine from the repository reaches the Culebra.

194.23(c)(2)
Section 194.23(c)(2) requires, among other things, “...reports on code verification,

benchmarking, validation, and quality assurance procedures."

The Requirements Document and the Verification and Validation Plan for the NUTS computer code establishes the criterion that "the integrated sum of releases passing any point of interest should be less than the integrated release from the repository." However, this does not prove that mass is being conserved, nor is evidence of mass balance provided elsewhere in the documentation.

The Department needs to perform a mass balance analysis on the NUTS computer code.

194.23(c)(2)
Section 194.23(c)(2) requires, among other things, "...reports on code verification, benchmarking, validation, and quality assurance procedures."

Regarding the GRASP-INV computer code, the CCA does not demonstrate that the incorporation of categorical simulation into GRASP-INV produces statistically valid unbiased transmissivity fields. As a result it is possible that the categorical simulation produces a statistical bias in favor of long Culebra travel times. The existing functional requirements and tests address many of the ancillary functions needed by the performance assessment, but the actual validity of the transmissivity fields to provide the statistical distributions of model predictions needed by the performance assessment is not tested.

An end-to-end requirement and test is particularly important in view of a recent change to GRASP-INV. The INTERA pilot point method (PPM) used to produce calibrated transmissivity fields was recently changed by adding a categorical simulation front end. This was done because of the outcome of the work of the geostatistics expert panel (GXG), applying different methods to four test problems.

Beyond questions about categorical simulation, it is important to have an end-to-end requirement and test for the pilot point method itself. A paper by Keidser and Rosbjerg is referenced in the GRASP-INV User's Manual in support of the pilot point method. The User's Manual states that the comparison that Keidser and Rosbjerg did of four inverse methods for determining transmissivity showed that the pilot point method is the best at reproducing large local heterogeneities. However, Keidser and Rosbjerg also say that the pilot point method is not the best for future predictions and did not perform well in the presence of measurement and model errors. They say it is "flexible enough to fit the observed short-time migration of the plume, but the continued simulation of the plume is more exposed to distortion when based on these local-scale corrections". But it is the statistical distribution of model predictions that the CCA really needs from GRASP-INV.

The Department needs to develop a code requirement and test the end-to-end statistical validity of the simulated transmissivity fields to provide the probabilistic inputs for the performance assessment.

194.23(c)(2)
Section 194.23(c)(2) requires, among other things, "...reports on code verification, benchmarking, validation, and quality assurance procedures."

The GRASP_INV computer code user's manual describes a number of test problem computer runs. However, none of the test runs is similar to the way in which the code is implemented in the performance assessment. It is also never stated in the documentation that the GRASP-INV code has been tested in a manner in which it will be implemented in the performance assessment.

The Department needs to provide evidence that the GRASP-INV code was tested in a manner in which it will be implemented in the performance assessment, and provide a sample computer run that corresponds to the CCA results.

194.23(c)(4)
Section 194.23(c)(4) requires "detailed descriptions of data collection procedures, sources of data, data reduction and analysis, and code input parameter development."

A low transmissivity region appears consistently in the calibrated transmissivity fields in the eastern portion of the site where there are limited data (Appendix TFIELD). From the histogram of Culebra transmissivity data, the P-18 data point could be argued to be a statistical outlier. Given the large variation of transmissivity data over the wider region, the P-18 data point could also be valid. If the low transmissivity region is an artifact, then it will bias some travel times high.

The Department needs to determine whether there are any physical explanations for an artificially low transmissivity data point at P-18, and provide evidence to explain how one data point can produce low transmissivity in a region far separated from that data point. The transmissivity fields need to be calibrated with the P-18 data point removed to verify that the low transmissivity region is due to the single data point at P-18.

Waste Characterization

l94.24(a)
This section requires DOE to provide information on the chemical, radiological and physical composition of waste proposed for disposal at WIPP. The information shall include waste components and their approximate quantities in the waste.

The Transuranic Waste Baseline Inventory Report (BIR) contains an estimate of complexing agents, nitrates, sulfates, phosphates, and cement. However, this inventory of complexing agents (important to the solubility of actinides) is based on uncertain plans that Idaho National Engineering Laboratory (INEL) will vitrify the waste destined for WIPP, therefore, reducing the quantity of complexing agents and other waste components. This is inconsistent with the assumptions for waste form in the performance assessment, which assumes no vitrification or

other waste form modification.

The Department needs to rectify this inconsistency between the BIR and the assumptions regarding waste form in the performance assessment.

Scope of Performance Assessment

194.32(a)
Section 194.32(a) states that "Performance assessments shall consider..., deep drilling,... that may affect the disposal system during the regulatory time frame."

Section 6.4.7.1 of the CCA indicates that all E1 and E2 intrusions that drill through waste rooms will also drill through Marker Bed-139 (MB-139) which is located 1.38 meters beneath the waste rooms. Models predict that MB-139 will contain brine that has drained from the waste rooms and is presumably contaminated (see CCA, page 9-97). Also, Appendix SCR, page SCR-114 states that there are 0.13 EPA units of radioactivity expected in MB-139. However, the contribution of direct releases from cuttings or brine in MB-139 releases would be additive to all other direct releases (cutting/cavings, spallation, direct brine release) for each realization. Values that are a fraction of an EPA unit could be an important contributor to repository releases.

DOE needs to provide justification of the impact of brine contamination expected in MB-139 and determine if this source needs to be added to the performance assessment.

194.32(e)(3)
Section 194.32(e)(3) requires the compliance application to include information which documents why any process, event, or sequence and combinations of processes and events identified pursuant to paragraph 194.32(e)(1) were not included in the performance assessment results provided in the compliance application.

The DOE has provided rationales and justification for the decisions concerning the elimination or retention of features, events and processes (FEPs) in the screening process described in Appendix SCR. The arguments presented in Appendix SCR are based on numerical assessments of low probability of occurrence of the process or event during the regulatory time frame or quantitative estimates of consequences that are then argued to be insignificant to performance of the disposal system as a whole or to a subpart of the system. In lieu of quantitative evaluations, DOE often presents qualitative arguments (sometimes called "reasoned arguments") to eliminate events and processes from consideration in performance assessments.

The Department needs to provide additional documentation for the quantitative and qualitative arguments in Appendix SCR for the following:

Natural FEPs - Regional Uplift

Page SCR-6 identifies a regional uplift over ten thousand years of approximately 1 meter.

The Department needs to provide a reference for that number.

Natural FEPs - Deformation

Page SCR-7 dismisses deformation on the basis of low probability based on the results of
rock mechanics studies described in Appendix DEF without citing any quantitative data of estimated deformation rates in the text.

The Department needs to provide some quantitative assessment of rates developed from the rock mechanics studies referenced in Appendix SCR to support the low probability decision.

Natural FEPs - Deep Dissolution

The discussion on pages SCR-15 and SCR-16 regarding deep dissolution presents abbreviated summaries of contrasting geologic interpretations of these features by a number of investigators without definitively settling the issue in favor of one over the other. The statement that subsidence at the San Simon Sink (20 miles from the site) has occurred in historic times and has been attributed to deep dissolution appears to leave the possibility open for active deep dissolution. Comments by Anderson on DOE/WIPP 94-019, the Compliance Status Report (Docket entry A93-02, IID-22, 7/14/94 Anderson to Lovejoy), point out dissolution features not mentioned in the CCA. Additional descriptive information in the text is used to link dissolution features to the Capitan Reef and a conclusion is presented that deep dissolution is eliminated on the basis of low probability.

The Department needs documentation to explain how the deep dissolution rate was estimated; how it was used to demonstrate that the probability of affecting the controlled zone (or the repository) is well below the probability cut-off; and address the dissolution features mentioned in the Anderson communication.

Natural FEPs - Climate Change

Page SCR-30 states that the effects of climate change are accounted for in performance assessments by increases in recharge of the Culebra. Anderson has commented extensively on the development of karst dissolution and linked it to climatic fluctuations, along with estimates of expected continued development and consequent salt dissolution effects (comments on DOE/WIPP 94-019, the Compliance Status Report, Docket entry A93-02, IID-22, 7/14/94 Anderson to Lovejoy). The alternative karst development has implications for the fundamental flow mechanisms in the Culebra (the nature and extent of fracture flow).

The Department needs to address Anderson's hypotheses specifically to discount them

with more thorough analyses or data, or the results of modeling to show the proposed effects are bounded by the CCA assessments.

Consideration of Drilling Events in Performance Assessments

194.33(c)(i)
Section 194.33(c)(i) on future drilling practices requires that "...such future drilling practices shall include, but shall not be limited to: ...the fraction of such boreholes that are sealed by humans..."

Section 6.4.7.2 of the CCA provides this information as the fraction of recently drilled (since 1988) boreholes that had been declared by the owners to be shut-in or temporarily abandoned that were eventually plugged. A survey indicated that 100% were plugged. However, there has been a recognized problem in recent years in the Delaware Basin of inactive wells that have never been declared as shut-in or temporarily abandoned by their owners. Appendix DEL (page DEL-45) recognizes one category of such wells (orphan wells whose owners cannot be located). Also, Table DEL-2 indicates an increase in active wells in southeastern New Mexico (since 1971) that is 7,428 wells less than the number of wells drilled minus the number abandoned. Assumptions about the existence, location, and effectiveness of borehole plugs drastically affect calculated amounts of Castile or Culebra brines in the repository as well as their movement toward the accessible environment.

The Department needs to provide detailed information about the large number of unaccounted for wells (e.g. the 7,428 wells in Table DEL-2). The effect of non-plugged boreholes needs to be included in intrusion scenarios.

194.33(c)(i)
Section 194.33(c)(i) requires that future drilling practices remain consistent with present practices in the Delaware Basin. These practices include borehole plugs or seals.

Section 6.4.7.2 assumes that all intrusion borehole plugs were effectively emplaced (i.e., the boreholes are completely sealed). No evidence is provided in Appendix DEL or it's attachments to support this assumption. Only about one-half of plugging operations on Bureau of Land Management (BLM) land are inspected by BLM during plugging and there is no indication of follow-up studies to determine effectiveness of emplaced plugs. This assumption is potentially important because defective 2-plug or 3-plug configurations could result in increased flows between Castile brine reservoirs, the repository, and the Culebra aquifer.

The Department needs to provide documentation on the percentage of plugs that are assumed to be effectively emplaced and the basis for the assumption.

194.34(c)
Section 194.34(c) requires documentation of computational techniques used in generating

complementary, cumulative distribution functions.

Although the general approach to sampling of parameters is described briefly in Chapter 6, the User's Manual for Latin Hypercube Sampling (LHS), and Appendix PAR, no detailed discussion of the LHS procedure is included. The User's Manual contains a brief discussion of the advantages of this approach, but it does not clearly describe the implementation of the method.

The Department needs to provide a detailed discussion of the LHS procedure and its implementation.

Passive Institutional Controls

194.43(a)
Section 194.43(a) requires "Any compliance shall include detailed descriptions of the measures that will be employed to preserve knowledge about the location, design, and contents of the disposal system."

DOE may assume only that the passive institutional control (PIC) design as proposed will satisfy the compliance criteria, not that the design as it is constructed 100 years in the future will do so. Chapter 7 of the CCA and related appendices leave open the possibility that the conceptual design that is finally implemented could be radically different from anything that might be approved by EPA during the period of its regulatory authority. For instance, Appendix PIC states, "It should be noted that the illustrations used to support this conceptual design report are not intended to represent the final configurations. Rather they are for the purpose of representing the type of configurations which are intended to be used in the final design." [Page 4] The explanation of DOE's schedule for implementation does not allow EPA to evaluate the proposed design as a final design. As a result, DOE's commitment to a specific design and the Department's ability to implement the design as proposed are rendered ambiguous.

EPA acknowledges that, if the WIPP is certified, the conceptual design as proposed in the initial application is likely to undergo substantial modification over the course of several decades as our knowledge and technical capabilities expand. Nevertheless, EPA cannot certify an undefined "final design" as it may exist 100 years in the future. EPA considers it more appropriate to assume for the purpose of certification that the conceptual design that is proposed is the same one that will be implemented.

The Department must provide more explicit information in support of its proposed design and schedule for implementation of PICs. At a minimum, this information should include:

- *which steps DOE can and cannot accomplish during the operational period and the reasons why;*

- *the rationale behind the timing of the various stages of implementation;*
- *specific actions that DOE will take to test PICs, when those actions will occur, and what DOE expects to learn by testing -- especially in terms of how testing could lead to substantial modifications to the conceptual design; and*
- *evidence that DOE, in proposing the design as practicable, gave serious consideration to the amount of time, human effort, and money likely to be required to implement the major aspects of the design.*

For example, the statement that "this design concept will be revisited over the operational lifetime of the WIPP" lacks explication (Section 7.3, Par. 2). The process of re-certification offers an obvious opportunity for DOE to notify EPA of improvements to the conceptual design throughout the 35-year period of disposal and decommissioning. Yet "revisitation" during the operational period is not accounted for in the chapter. In fact, it appears from the time line represented in Figure 7-16 (Page 7-83) that most of the work that will inform any revisions to the design will be conducted after the operational period. The areas in which DOE anticipates modifying the conceptual design during the operational period are not clearly identified.

Engineered Barriers

194.44
Section 194.44 requires that the disposal system incorporate engineer barriers designed to prevent or substantially delay the movement of radionuclides toward the accessible environment.

While the inclusion magnesium oxide (MgO) as a backfill material will improve repository performance, the Department must provide an engineering design which supports the assertions about the performance of MgO. The evidence must support the assumptions used in PA.

The Department must provide an engineering design which provides the method of placement and quantity emplaced such that the MgO will be distributed as assumed in the conceptual models to support the reaction of MgO to be as predicted in the expected WIPP repository environment. The Department must also provide information which demonstrates that the excess volume proposed to be emplaced can actually be accommodated and whether it covers the uncertainties in the actual geochemical processes.

Consideration of Protected Individual

194.51
Section 194.51 requires, among other things, that exposure from all sources of radionuclide release from the disposal system to the accessible environment be examined.

Chapter 8 of the CCA provides a bounding analysis to demonstrate compliance with 40 CFR

191.15. However, the analysis only assumes exposure via consumption of potable water. It does not explicitly include the analysis of doses posed by other potential exposure pathways such as stock consumption or irrigation.

The Department needs to provide documentation which discusses why pathways other than consumption of potable water are not considered.

Consideration of Underground Sources of Drinking Water

194.53
Section 194.53 requires that all underground sources of drinking water in the accessible environment to be affected by the disposal system over the regulatory time frame be analyzed.

Section USDW3.31 of the CCA indicates that the Capitan Aquifer has been determined by DOE not to be a USDW that could be affected by the disposal system.

The Department needs to justify why the Capitan Aquifer cannot be affected by the disposal system over the regulatory time frame.